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FLOOD INSURANCE STUDY

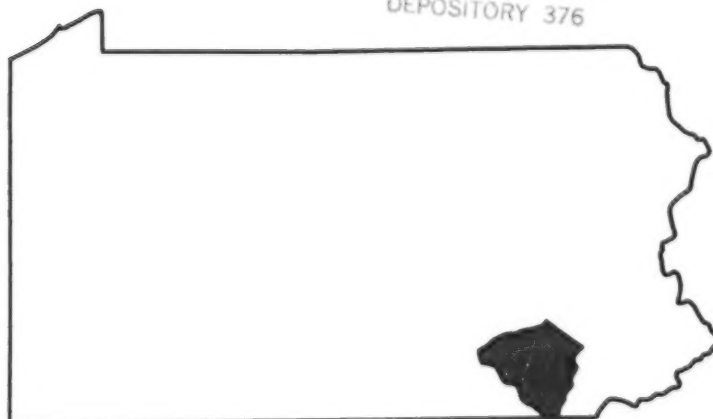


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**TOWNSHIP OF
SALISBURY,
PENNSYLVANIA
LANCASTER COUNTY**



OCTOBER 15, 1980



**federal emergency management agency
federal insurance administration**

COMMUNITY NUMBER - 421783

FEM 1-289



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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
TOWNSHIP OF SALISBURY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Salisbury, Lancaster County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Salisbury to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Roy F. Weston, Inc., for the Federal Insurance Administration, under Contract No. H-4743. This work was completed in October 1979.

1.3 Coordination

Principal flood problems and existing flood plain regulations and conditions were discussed at a meeting held in October 1978 with township officials and Roy F. Weston, Inc. (study contractor). In May 1979, community base maps were selected and the streams requiring detailed study were identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of the FIA, the Township of Salisbury, and the study contractor. On May 14, 1980, a final CCO meeting was held with the FIA, the township, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Salisbury, Lancaster County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

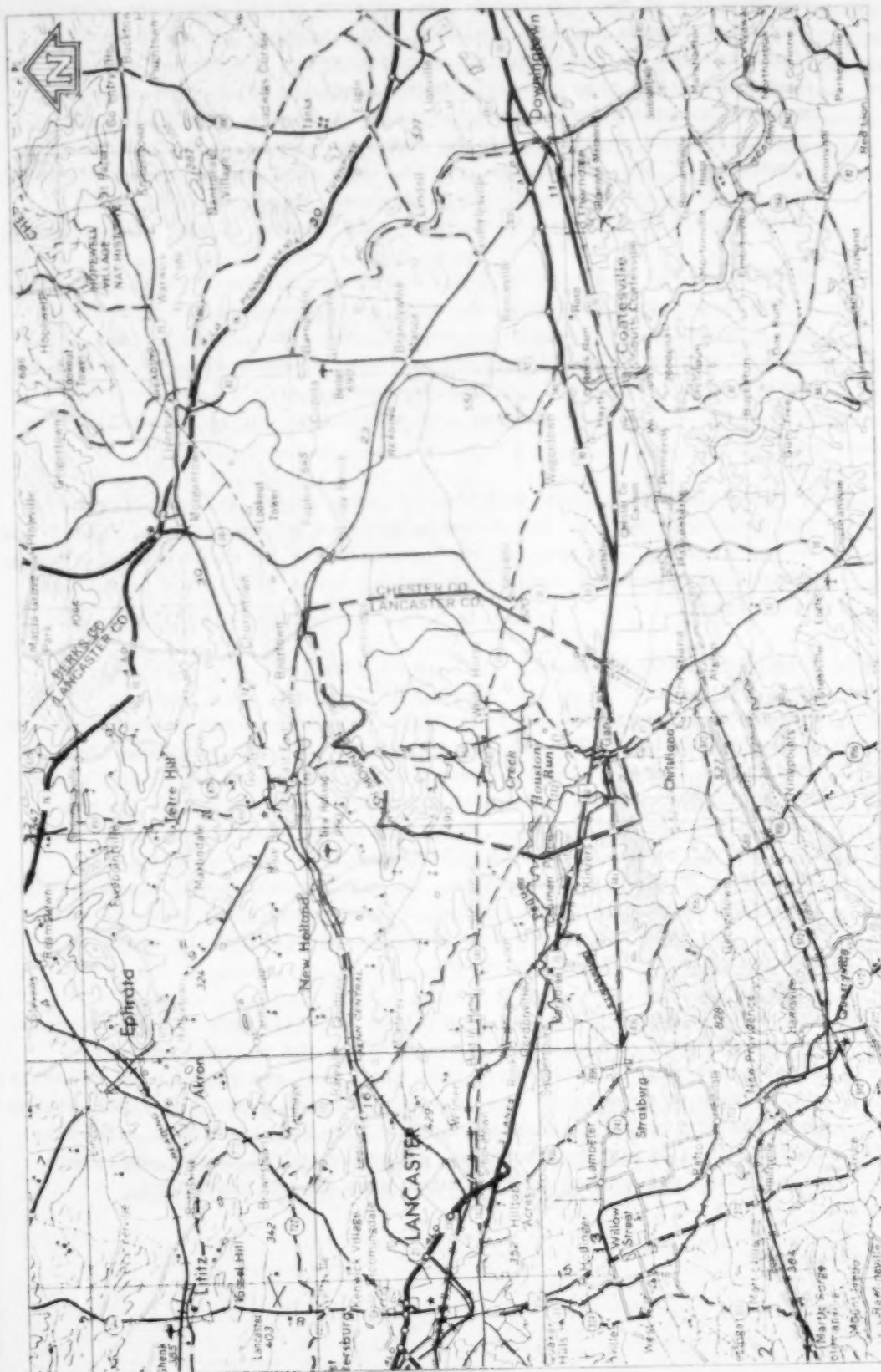
Houston Run was studied by detailed methods from Route 30 to Strasburg Road. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through October 1984.

Houston Run from upstream corporate limits to Route 30, and from Strasburg Road to downstream corporate limits, Pequea Creek, Pequea Run, Umbles Run, Richardson Run, Indian Spring Run, and several unnamed tributaries were studied by approximate methods. Approximate methods of analysis were used to study those areas having low development potential and minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the FIA.

2.2 Community Description

The Township of Salisbury is located in the east-central portion of Lancaster County in southeastern Pennsylvania. It is bordered by the Townships of East Earl and Caernarvon to the north, the Townships of Earl, Leacock, and Paradise to the west, the Township of Sadsbury to the south, and the Townships of West Sadsbury, West Caln, and Honey Brook to the east. The population of the township in 1970 was 5,294, a 17.4-percent increase from 1960 (Reference 1).

In 1710, Robert Gault, an immigrant from Ireland, began farming the rich limestone soil. The early settlers who discovered the rich productive farmland chose to establish roots in the township previously known at the Pequea Valley. The township, named after Salisbury in England and laid out in 1729, was one of the original townships of Lancaster County. Villages sprang up at crossroads and served as commercial centers. In addition to farming and commerce, the township became an important mining center, especially for nickel deposits. In recent years, the township has been experiencing a rush in residential development as part of the urban sprawl of Philadelphia and Wilmington.



APPROXIMATE SCALE



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VICINITY MAP

FIGURE 1

The general area of the township is located on the Piedmont Plateau, a province of the Appalachian Highlands. The township lies at the conjunction of two sub-areas; the uplands of the southern portion of Lancaster County and the lowlands. The geology of the township is characterized by the Cambrian and Ordovician limestones of the Cambrian period that underlie more than half of the township, metamorphosed intrusive igneous rocks of the Pre-Cambrian era, the quartzites and phyllites of the Cambrian period, and the Conestoga limestone of the Ordovician period. The soil associations found in the township are the Duffield-Hagerstown, Conestoga-Hollinger, Neshaminy-Aldino, Edgemont-Cardiff, and Chester-Glenelg associations.

The climate of the area is humid continental, characterized by moderate temperature changes, abundant and dependable precipitation, and a relatively long growing season which averages 160 days. The typical pattern of mild winters and warm summers results in a mean annual temperature of 52.5 degrees Fahrenheit (°F), an average annual rainfall of 43 inches, and an average annual snowfall of 24 inches.

Historically, Salisbury depended on agriculture as the backbone of its economy; however, the dense network of transportation facilities in the area rapidly changed the growth trend of the township from an agriculturally-based economy to one of urban growth and industrial development.

2.3 Principal Flood Problems

Salisbury is fortunate in that major flooding is not a widespread or frequent problem. The main storm seasons for the area are the spring and summer. During these times, intense rainfall may occur for short periods of time, with an associated quick rise in the water elevation of streams. This situation typically causes the flooding of roads, but major flood damage has not usually been suffered. Tropical Storm Agnes, the most recent major storm in the township, did cause flood damage to low-lying structures and roads. This storm resulted in a flood which was approximately equal to a 100-year flood for the township.

The lack of severe flooding conditions in Salisbury is attributable to the physical features of the watershed and stream channels. Equally important is the fact that the local residents have generally not attempted to develop the low-lying stream banks and flood plains. Good farming methods, such as contour plowing, have been effective factors in alleviating flooding, as agricultural lands comprise a significant percentage of the total area in the community.

Flooding along roads in the township is caused primarily by inadequate drainage. At some locations, flood levels are increased due to the limited carrying capacity of stream culverts. During storms, trees, trash, and other debris may be washed away and carried downstream, collecting on bridges and obstructing streamflow. The accumulation of debris greatly reduces the limited capacity of bridges and culverts, increases flooding into unpredictable areas, increases velocity of flow immediately downstream, and erodes culvert entrances and bridge approach embankments.

2.4 Flood Protection Measures

Salisbury has no major structures which are intended solely for flood control. The township does, however, use the Flood Hazard Boundary Map to help guide flood plain development (Reference 2). The township supervisors have developed a flood plain ordinance, which has been accepted by the Township of Salisbury Planning Commission. The Lancaster County Planning Commission also provides assistance in the development of flood plain regulations and has recently prepared sample flood plain zoning provisions designed to meet the requirements of the FIA.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

There are no gages on Houston Run. Therefore, several standard methodologies that are generally accepted for engineering studies in Pennsylvania were used for the determination of flood flows at ungaged stream locations (References 3, 4, and 5).

The PSU III method was selected for Houston Run (Reference 3). This technique was developed for specific use in estimating flood peak flow rates for ungaged sites in Pennsylvania. The use of the PSU III is consistent with hydrologic studies performed by the Pennsylvania Department of Transportation in the design of bridges for small streams in Pennsylvania. Flood-flow rates that were calculated for Houston Run were reduced by 40 percent to take into account flood-flow behavior in limestone basins.

A summary of drainage area-peak discharge relationships for Houston Run is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

<u>FLOODING SOURCE AND LOCATION</u>	<u>DRAINAGE AREA (sq. miles)</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-YEAR</u>	<u>50-YEAR</u>	<u>100-YEAR</u>	<u>500-YEAR</u>
HOUSTON RUN					
At Lincoln Highway bridge	1.06	150	220	260	330

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along this flooding source.

Cross-section data for Houston Run were obtained using aerial photogrammetric techniques, with the below-water sections being obtained by field measurement (Reference 6). All bridges and culverts were field-surveyed to obtain elevation data and structural geometry.

Channel roughness factors (Manning's "n") used in the hydraulic analyses were assigned on the basis of field inspection and aerial photographs of flood plain areas. The channel roughness factors for Houston Run ranged from 0.045 to 0.050, and the overbank roughness factors ranged from 0.050 to 0.090. The high values are associated with thick tree and brush overbanks which exist along some reaches in the study areas.

Water-surface elevations of floods of the selected recurrence intervals were developed using the HEC-2 step-backwater computer model (Reference 7). The starting water-surface elevations for Houston Run were developed by the slope/area method, as described in the HEC-2 documentation (Reference 7).

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the

community. For the stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:12,000 with a contour interval of 5 feet (Reference 6). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The approximate flood boundaries were delineated using the Flood Hazard Boundary Map for the Township of Salisbury (Reference 2).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as a minimum standard that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

FLOODING SOURCE	PANEL ¹	ELEVATION DIFFERENCE ² BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION ³ (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Houston Run Reach 1	15	-0.7	-0.2	+0.4	005	A1	Varies

¹Flood Insurance Rate Map Panel
²Weighted average
³Rounded to the nearest foot - see map

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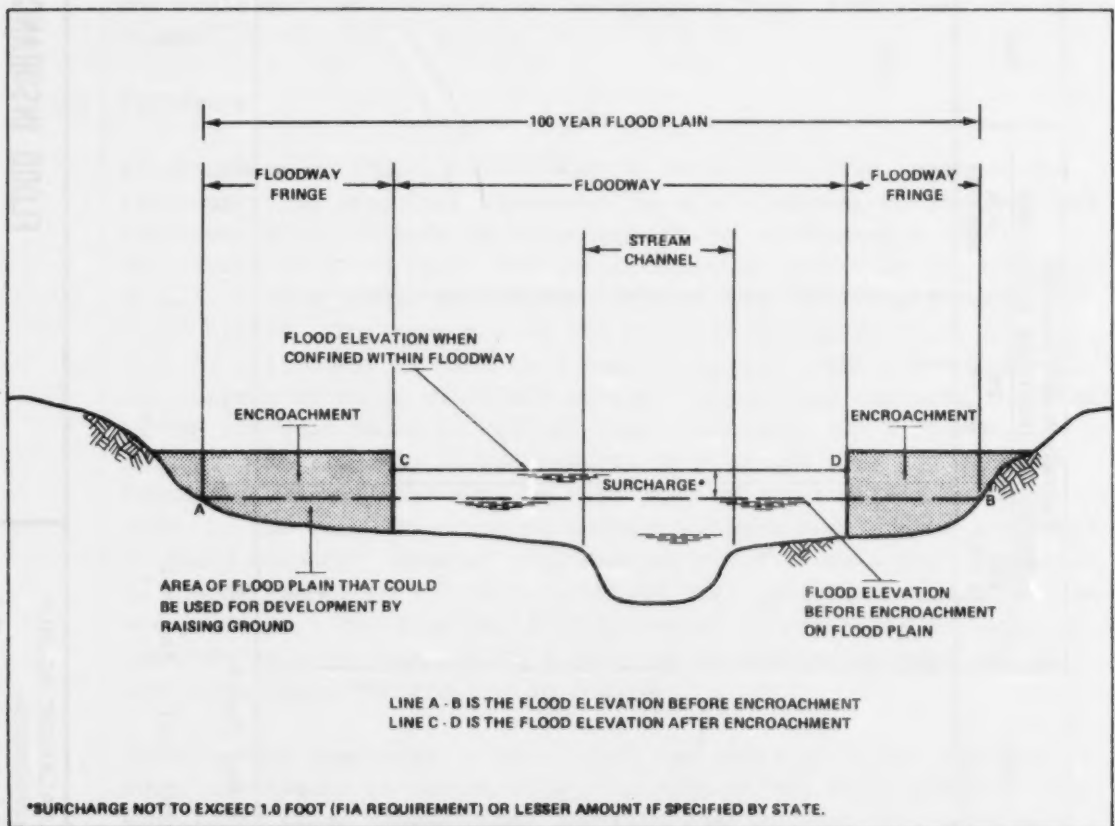
FLOOD INSURANCE ZONE DATA

HOUSTON RUN

TABLE 3

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.



FLOODWAY SCHEMATIC

Figure 2

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF's), and flood insurance zone designations for the flooding source affecting the Township of Salisbury.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

<u>Average Difference Between 10- and 100-Year Floods</u>	<u>Variation</u>
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding source of the Township of Salisbury are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF's are used to set actuarial insurance premium rate tables based on FHF's from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Houston Run								
A	120	20	65	4.1	438.2	438.2	438.2	0.0
B	1,040	45	120	2.2	448.8	448.8	449.5	0.7
C	2,240	25	40	6.7	457.1	457.1	457.2	0.1
D	3,400	15	75	3.6	465.8	465.8	465.9	0.1
E	4,370	25	45	6.0	493.6	493.6	494.0	0.4

¹Feet above U. S. Route 30

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FLOODWAY DATA

HOUSTON RUN

TABLE 2

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHF's, the entire incorporated area of the Township of Salisbury was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHF's determined.

Zone A1: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHF's, flood insurance zones, and base flood elevations for the flooding source studied in detail in the Township of Salisbury.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Salisbury is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

The Flood Insurance Study for the Township of Leacock has been prepared (Reference 8). The results of this study are in exact agreement with the results of that study. Also, the Flood Hazard Boundary Map for the Township of Salisbury has been published (Reference 2).

The Flood Insurance Study for the Township of Paradise is currently being prepared (Reference 9). The results of that study will be in exact agreement with the results of this study.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this report can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

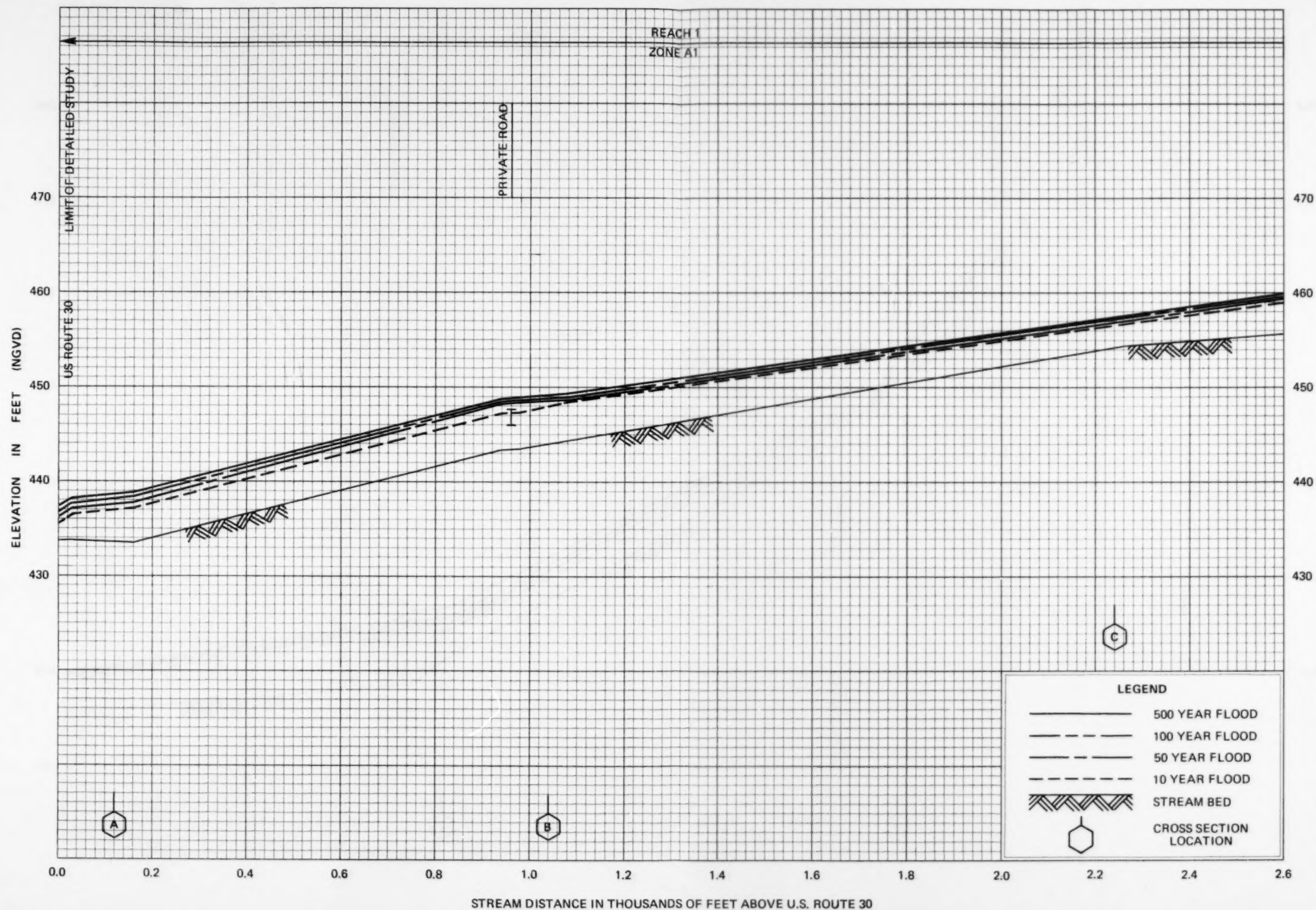
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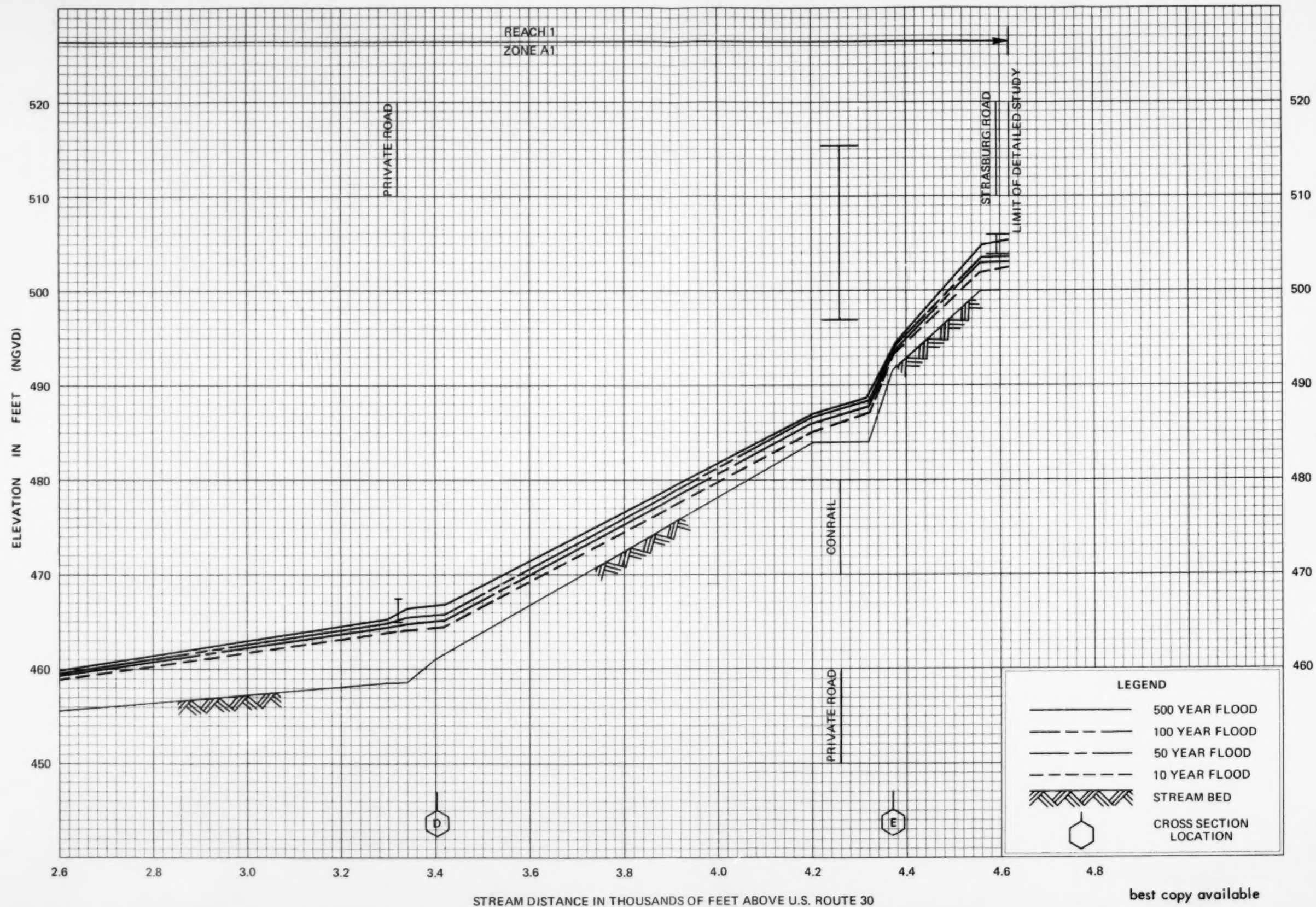
FLOOD PROFILES

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